SKYVIEW: THE MULTI-WAVELENGTH SKY ON THE INTERNE

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1. Introduction

The *SkyView* virtual observatory provides a single, simple interface where users can retrieve images of the sky at all wavelengths from the radio through gamma rays. Below we discuss how *SkyView* works and how it represents a new paradigm in astronomical data archives. Users get to *SkyView* over the WorldWideWeb at `http://skyview.gsfc.nasa.gov`. Within a few moments they can have high-quality images from ground- or satellite-based surveys.

Surveys currently in *SkyView* include the optical Digitized Sky Survey, the IRAS Sky Survey Atlas, COBE DIRBE data, five radio surveys, the EUVE and ROSAT/WFC all-sky surveys, the Compton EGRET and CompTel surveys, ROSAT PSPC pointed observations and others.

SkyView addresses two problems which inhibit astronomers from using survey data. First, *SkyView* provides a single contact point and a single interface to all of these different surveys regardless of origin. Second, the system allows the user to specify how the image is to be created without regard for its native format. The user does not need to know the underlying coordinate system, equinox, scale, or orientation of the image, nor how the data for a survey may be subdivided. *SkyView* transforms, precesses, rescales, rotates and mosaics the image as appropriate. Users are relieved of understanding the geometric details of the data and may immediately begin to do astronomy.

2. A New Archive Paradigm

SkyView presages a needed shift in how we view archives: as the community is inundated with data from surveys like 2MASS and Sloan, our archive

systems need to do more than point out where data is for our users, they need to assist in getting users the data in an immediately useful form. Most astronomical archives that have been built up till now have used what is essentially a library paradigm. The archive comprises a set of indivisible atoms (or books or observations). These atoms are indexed in some catalog. The users first search the catalog for the atoms of interest and then check out (or copy) those observations. *SkyView* goes beyond this. Rather than just lending the books in the archive's shelves, the *SkyView* server reads the books and writes a report based on them which specifically addresses the user's needs. To do this *SkyView* has built into it a substantial understanding of the geometry of astronomical images.

3. Building Archives in the Web

The advent of the Web has accelerated the explosion in the amount of digital astronomical information available. While individual astronomers have found the Web extraordinarily helpful in locating and distributing information, data providers are only now beginning to recognize the possibilities implicit in this new technology. While a Web form may be designed for interactive use, each form is essentially a view into the resources of the organization providing the data. It can be used not only by a user interactively, but by services at other data providers. *SkyView* is using a vast array of Web services to provide its own specialized interface for users. Already it uses the NED and SIMBAD name resolvers to translate names into positions, talks to the HEASARC catalog services to get more than 150 astronomical catalogs, and has begun to retrieve catalog data and images from the University of Minnesota. The time of monolithic data services is ending.

4. Status and Future Plans

In two years *SkyView* use has grown to between 15,000 and 20,000 images generated each month. While most of these are to support astronomical research we estimate that perhaps one-third of the images are retrieved by amateur astronomers and other interested members of the public. Our simple Web interfaces are very useful for scientists but also give the public a window into the world of astronomical research.

New surveys are constantly being incorporated into *SkyView*. Both two-dimensional images, and three-dimensional data, *e.g.*, line surveys, are included. We welcome suggestions for new surveys to be added. In the near future we shall be opening new *SkyView* archives for limited regions which have been especially well-studied in multiple wavelengths such as the Galactic Plane and M31.